Pioneer Mission Support

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This article reports on activities within the Deep Space Network in support of the Pioneer Project's in-flight spacecraft during the period August 1977 through January 1978. The amount of tracking coverage provided by the Network and a summary of operational testing of the Mark III Data Subsystems at DSSs 42/43 and 61/63 are presented.

I. Pioneers 6, 7, 8, and 9

As indicated by Table 1, coverage of these spacecraft has decreased from the levels of the last reporting period (Ref. 1). A total of 26 tracks were conducted during August, primarily for the acquisition of radio metric data to be used for trajectory updating. In the following months, coverage was minimal due principally to increased Network loading in support of higher priority users. Tracks in the months subsequent to August were used primarily to verify Mark III Data Subsystem (MDS) performance at the Deep Space Stations.

All of these spacecraft celebrated launch anniversaries during this reporting period. Pioneer 7 was eleven years old on 17 August, Pioneer 9 was nine years old on 8 November, Pioneer 8 was ten years old on 13 December, and Pioneer 6 was twelve years old on 16 December. In general, all four spacecraft have continued operating normally. The principal exception was Pioneer 8 which experienced a severe degradation in one of its sun sensors. The extent of the degradation will not be known until the spacecraft reaches perihelion when the sensor may be able to detect the sun.

The degraded sensor provided the spacecraft roll reference and sun pulse. Without the sun pulse, most scientific data are useless as the instruments have no pointing information with which to correlate their measurements. As a consequence, all instruments have been powered down; the plasma analyzer will be turned on whenever the spacecraft is tracked since data may be recovered from this instrument even in the absence of the sun pulse.

II. Pioneers 10 and 11

Pioneer 10 continues to operate satisfactorily. The spacecraft is now almost 15 astronomical units (AU) from the earth and the round trip light time is over four hours. Tracking coverage has remained fairly constant since the last report. Coverage by the 26-metre stations has declined sharply as the spacecraft is approaching threshold for those facilities. Tracking coverage for the last six months is tabulated in Table 1 and coverage for the last twelve months is shown graphically in Fig. 1.

Pioneer 11 is also operating normally. Earth-spacecraft range is now approximately 5.5 AU and the round-trip light time is over one and one-half hours. Tracking coverage is shown in Table 1 and Fig. 2 for the past six months and twelve months, respectively.

On 3 August, the spacecraft passed through its fourth superior conjunction at a minimum earth-Sun-probe angle of 9.°05 (approximately 33.3 $R_{\odot}$). No significant telemetry degradation was observed at this great an angular separation. Some increase in Doppler noise was experienced, as shown in Fig. 3, but this enhancement was somewhat less than that expected.

The plasma analyzer on Pioneer 11, which ceased operation in April 1975, began to output data again on 4 December. Since that date, the instrument has responded to ground commands and appears to be fully operational. This experiment should provide much valuable data during the Saturn encounter in September 1979.

A Saturn targeting maneuver, scheduled for late January, has been delayed until mid-year in order to decrease the amount the spacecraft must be turned off earth-pointing. Current plans are for Saturn periapsis to occur outside the visible rings, but an option remains for a passage between the planet and its rings.

III. Mark III Data Subsystems Support of Pioneer

Since the previous report, Mark III Data Subsystem (MDS) verification testing for Pioneers 6 through 11 has been completed at DSSs 42/43 and 61/63. A total of nine demonstration tracks of the Pioneer spacecraft were conducted at DSS 42/43 between the date the station was returned to service (26 September) and the date of configuration control application (18 October). DSS 61/63 participated in 21 Pioneer demonstration passes during the period 3 January (return to service) and 31 January (configuration control application).

No significant, MDS-related anomalies were experienced throughout either period of verification testing. The majority of the minor anomalies encountered were related to operator training and familiarization. These problems decreased as operations personnel became more proficient and more knowledgeable of the new systems.

DSS 11 is currently undergoing upgrading to an MDS configuration. Verification testing of this station will begin in March and will follow the same pattern of demonstration passes as was used for the other stations of the Network. A future article will report on this testing.

Reference

1. Adamski, T. P., "Pioneer Mission Support," in *The Deep Space Network Progress Report 42-41,* pp. 33-38, Jet Propulsion Laboratory, Pasadena, Calif., October 15, 1977.

Table 1. Pioneer tracking coverage

Month	Spacecraft	Station Type	Tracks	Tracking Time hr:min
August	Pioneer 6	26 m	6	36:00
	Pioneer 7	26 m	12	69:56
	Pioneer 9	26 m	8	42:41
	Pioneer 10	26 m	1	4:35
		64 m	27	195:07
	Pioneer 11	26 m	85	527:38
		64 m	1	6:28
September	Pioneer 10	26 m	2	11:12
		64 m	29	225:50
	Pioneer 11	26 m	50	396:56
		64 m	2	14:00
October	Pioneer 7	26 m	4	18:21
	Pioneer 8	64 m	1	3:37
	Pioneer 10	26 m	1	4:35
		64 m	33	237:37
	Pioneer 11	26 m	49	315:51
		64 m	8	59:01
November	Pioneer 10	64 m	37	265:57
	Pioneer 11	26 m	47	364:06
		64 m	2	16:03
December	Pioneer 10	26 m	1	0:50
		64 m	40	267:53
	Pioneer 11	26 m	36	289:09
		64 m	5	28:33
January	Pioneer 6	26 m	1	7:40
	Pioneer 8	64 m	1	6:18
	Pioneer 9	26 m	1	5:34
	Pioneer 10	64 m	32	223:58
	Pioneer 11	26 m	50	341:38
		64 m	2	11:11

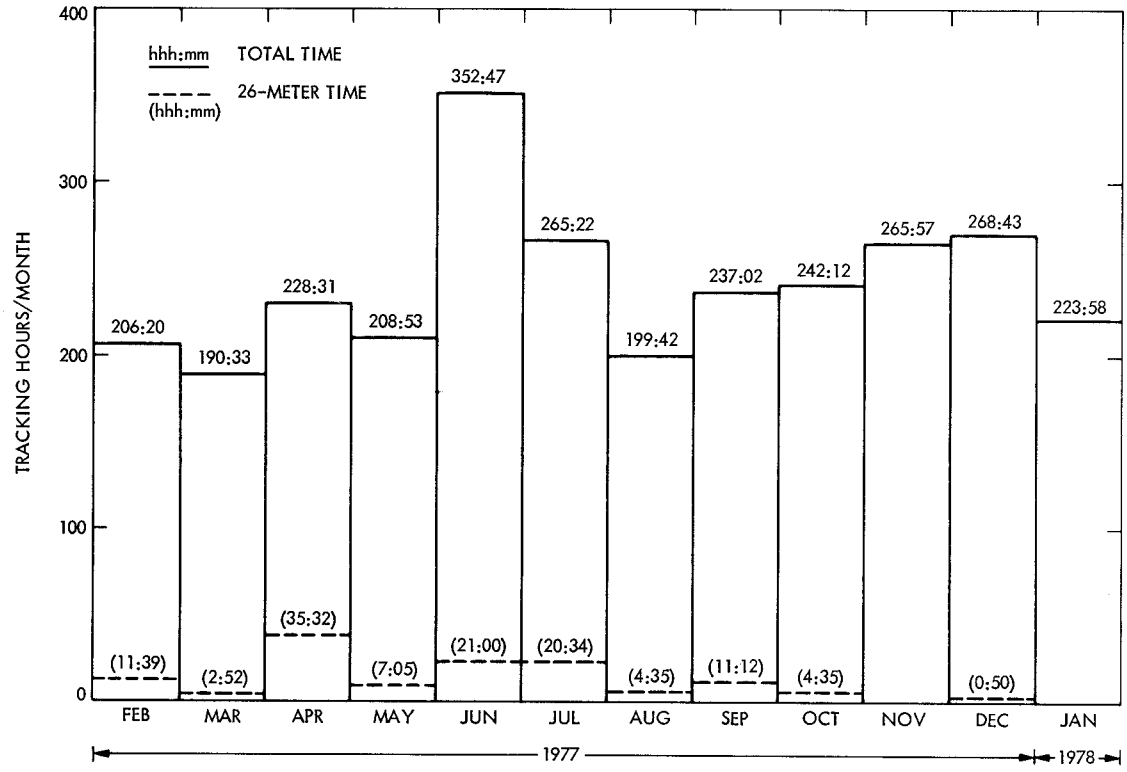

Fig. 1. Pioneer 10 tracking times

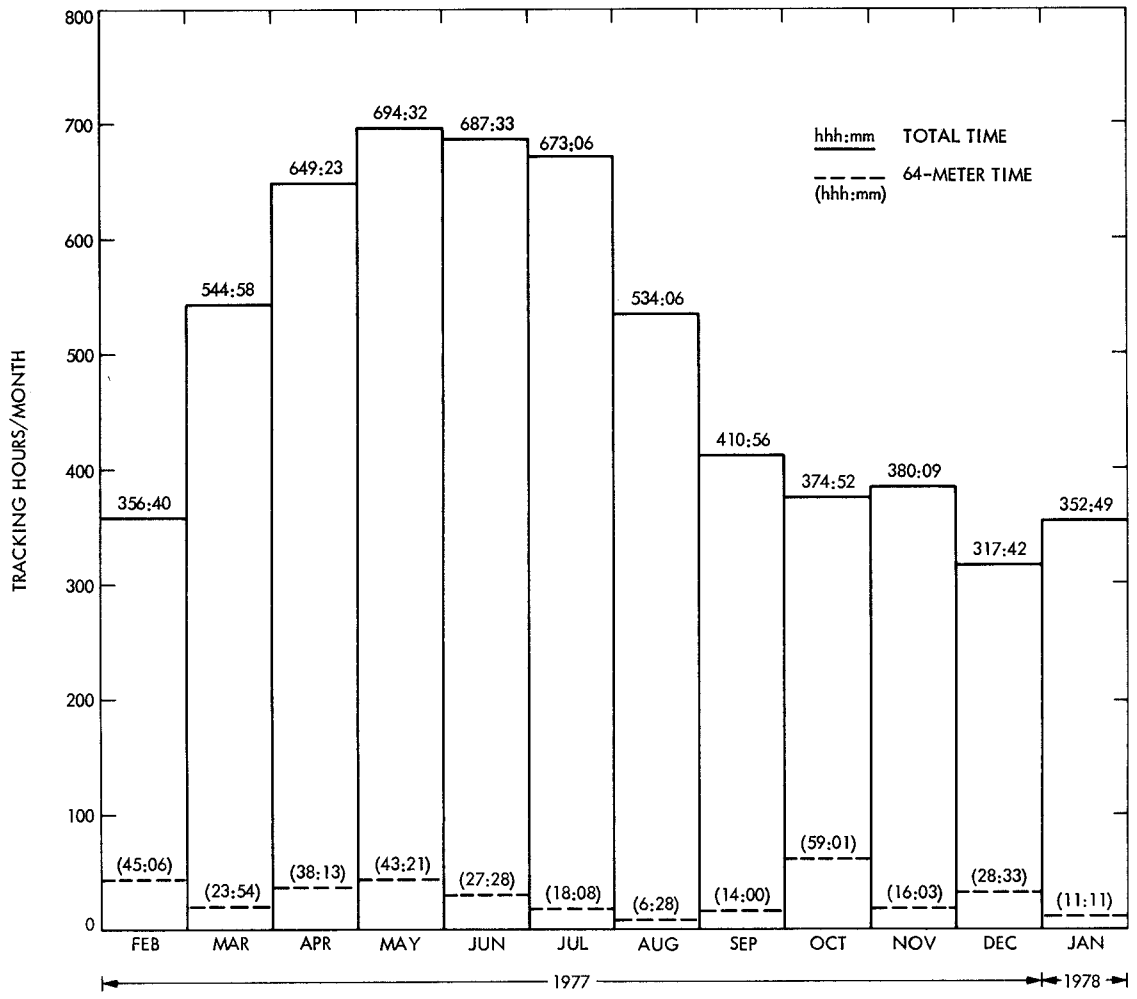

Fig. 2. Pioneer 11 tracking times

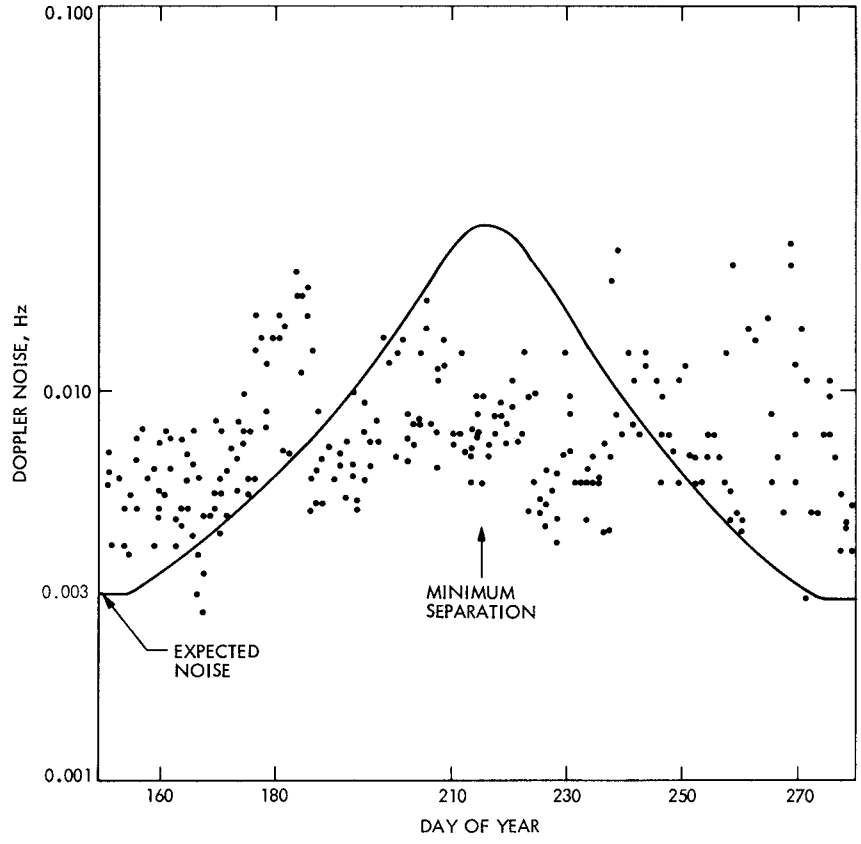

Fig. 3. Doppler noise during Pioneer 11 superior conjunction